Vector Control Needs Assessment -Mali

Integrated Vector Management (IVM) Task Order 2

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REPUBLIC OF MALI

VECTOR CONTROL NEEDS ASSESSMENT

(VCNA)

(DRAFT)

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ABBREVIATIONS AND ACRONYMS

ACTs:	Artemisinin Combination Therapy
AM:	Amplitude modulation
ANEH :	Agence nationale d'évaluation des hôpitaux
ANSSA :	Agence nationale de la sécurité sanitaire des aliments
ANTIM :	Agence nationale de télésanté et d'informatique médicale
ASEB :	Analyse de la situation et estimation des besoins en santé et environnement
ASP :	Africa Stockpiles Program
BCC :	Behavioral Change Communication
BCM :	Broad national Consultative Mechanism
Bti :	*Bacillus thuringiensis israelensis*
CADD-MS :	Cellule d'appui à la décentralisation / déconcentration du ministère de la santé
CBA :	Cone Bio-Assays
CDC :	Centers for Disease Control and Prevention
CEPRIS :	Cellule d'exécution des programs de renforcement des infrastructures sanitaires.
CILSS :	*Comité permanent Inter-état de lute contre la sécheresse dans le sahel*
CM :	Chargés de missions
CNAM :	Centre National d'Appui à la lutte contre la Maladie
CNIECS :	Centre national d'information et de communication pour la santé.
CNOS :	Centre national d'odontostomatologie
CNTS :	Centre national de transfusion sanguine
CPS :	Cellule de Planification Sectorielle
CREDOS :	Centre de recherche et documentation pour la survie de l'enfant.
CRLD :	Centre de recherche et de lutte contre la drépanocytose
CSCOM :	Centre de Santé Communautaire/Community health centers
CSLS :	Cellule du comité sectoriel de lutte contre le sida.
CSP	(*Comité sahelien des pesticides*)
CsRéf :	Centre de Santé de Réference
CT :	Conseillers techniques
DCPN :	Document Cadre de Politique Nationale
DDT :	Dichloro-Diphenyl-Trichloroethane
DEA :	Diplôme d'Etude Approfondie
DENV :	Dengue Virus
DHPS :	Division d'Hygiène Publique et Salubrité
DNCC :	Direction Nationale de la Concurrence et du Commerce
DNMCP :	Directorate of the National Malaria Control Program
DNS :	Direction Nationale de la Santé/National Directorate of Health
DRS :	Direction régionale de la santé/Regional Directorate of Health
ECOWAS:	Economic Community of West African States/
EIA :	Environment Impact Assement
EIRs :	Entomologic Inoculation Rates

EPA :	Etablissements publics à caractère administratif
EPH :	Etablissements publics hospitaliers
EPIC :	Etablissements publics à caractère industriel et commercial
EPP :	Etablissements publics à caractère professionnel
EPSTC :	Etablissements publics à caractère scientifique, technologique ou culturel
FAST :	Faculté des Sciences et Techniques/Faculty of Sciences and Techniques
FM :	Frequence Modulation
FMPOS:	Faculté de Médecine, Pharmacie et d'Odonto-Stomatologie
GIS:	Geographical Information System
GOM:	Government of Mali
GTZ:	The German International Cooperation Agency
GWD :	Guinea Worm Disease
HCC :	Haut Conseil des Collectivités/High Council of Collectivities
HIV/AIDS :	Human Immuno-deficiency Virus/Acquired Immune Deficience Syndrom
ICER :	International Center for Excellence in Research
IEC :	Information, Education and Communication
IER:	Institut d'économie rural/Rural Institute of Economy
INFSS :	Institut national de formation en sciences de la santé
INPS :	Institut National de Prévoyance Sociale
INRSP :	Institut national de recherche en santé publique
IOTA:	Institut d'Ophtalmologie Tropicale d'Afrique
IPTp:	Intermittent Preventive Treatment in pregnant women
IRS:	Indoors Residual Spraying
ITNs:	Insecticide-Treated bed Nets
IVM:	Integrated Vector Management
LBMA:	Laboratoire de Biologie Moleculaire Appliquee/Laboratory of Applied Molecular Biology
LCV:	Laboratoire Central Veterinaire/Central Veterinary Laboratroy
LF:	Lymphatic Filariasis
LLINs:	Long-Lasting Insecticidal Nets
LMVR:	Laboratory for Malaria Vector Research
LNE :	Laboratoire National de l'Eau
LNS :	Laboratoire national de la santé/National Laboratory of Health
LSM :	Larval Source Management
MATCL :	*Ministère de l'Administration Territorial et des Collectivités Locales*
MDGs:	Millenium Development Goals
MoH:	Ministry of Health
MRTC:	Malaria Research & Training Center
NDEP:	National Dracunculiasis Eradication Program
NIAID:	National Institute of Allergy and Infectious Diseases
NIH:	National Institutes of Health
NISC:	National Inter-Sectoral Committe

NLFEP: National Lymphatic Filariasis Elimination Program
NMCP : National Malaria Control Program
NTCP: National Trypasonosomiasis Control Program
NTDs: Neglected Tropical Diseases
OCP: Onchocerciasis Control Programme
OPV: *Office de Protection des Végétaux*
PASP-Mali: Programme Africain Relatifs aus Stocks Obsoletses de Pesticides/African Stockpiles of Pesticides
PATTEC: Pan-African Tse-tse and Trypanosomiasis Eliminiation Campaign
PDDS: Programme Decennal de Developpement Social
PDES : Projet de Développement Economique et Social/Project for Economic and Social Development
PMA : *Paquet Minimum d'Activité*
PMI: President's Malaria Initiative
PNACT: Programme National d'Appui aux Collectivités Territoriales
PPM : Pharmacie populaire du Mali
PRODESS : Health and Social Development Program
QA/QC : Quality Assurance/Quality Control
RBM : Roll Back Malaria
RDTs : Rapid Diagnostic Tests
RGHP : Recensement General de la Population et des Habitats/General Census of populations and Habitats
RTA : Rapport Trimestriel d'Activités/Quarterly Activities Report
RTI : Research Triangle Institute
SEPAUMAT : Service entretien parc auto et matériel.
SEREFO : HIV/AIDS and Tuberculosis Research and Training Center
SLIS : Système Local d'Information Sanitaire/Local Health Information System
SNIS : Système National d'Information Sanitaire/National Health Information System
TBRF: Tick Borne Relapsing Fevers
UEMOA: Economic and Monetary Union of West Africa/*Union Economique et Monetaire de l'Afrique de l'Ouest*)
UMPP : Usine malienne de production de produits pharmaceutiques
USA: United States of America
USAID: United States Agency for International Development
VBDs : Vector Borne Diseases
VCNA: Vector Control Needs Assessment
WHO: World Health Organization

EXECUTIVE SUMMARY

Insecticide-treated bed nets (ITNs), including long-lasting insecticidal nets (LLINs), indoor residual spraying (IRS), and in certain conditions larval source reduction strategies, remain effective interventions for reducing malaria morbidity and mortality. Despite the proven effectiveness of these interventions however, malaria remains the number-one killer of pregnant women and children under five years of age in many African countries. In 2004, WHO adopted integrated vector management (IVM) as the desired strategic approach for ecologically sound, cost-effective and sustainable control of vector-borne diseases, (WHO, 2004 also see WHO, 2008). WHO recommends vector control needs assessment (VCNA), as an initial step towards the development of a comprehensive national IVM strategy. This report presents the major findings of a 2011 VCNA for Mali. Current status of vector borne Diseases and related policies and plans for their control are reviewed. Needs and opportunities are identified for effective development a national IVM strategy in Mali, in terms of policies and strategies, institutional arrangements, implementation priorities, and monitoring and evaluation.

There is an absence of a comprehensive and overarching policy on vector control. The situation prevents appropriate placement and mobilization of vector control in the national disease control strategy. Very few of the vector borne diseases have adequate considerations within national policies, and where they exist, such policies have not been effectively translated into strategic plans. The majority of VDB programs only develop annual strategic or operational plans, which situation does not lend itself to multi-year and progressive strategic planning. Vector control, though recognized by national VBD programs as important, is either absent from operational plans, or not adequately elaborated. The exception to these observations is the malaria control program, which has a specific policy that has been translated into a strategic plan, although the plan needs further improvement. The national malaria control program has the most developed vector control component, comparatively.

Even though all VBDs control programs are under the ministry of health, there is no overarching sectoral policy on vector control. There is hardly any intersectoral planning between disease programs. The health impact of agriculture and environmental policies are not adequately assessed by the health sector, as they should be. A robust institutional framework is needed to augment Intersectoral collaboration, to address the linkages between environmental and agricultural policies and practices, and vector borne diseases effectively. The national policy of decentralization offers a unique opportunity to transition decision-making processes closer to the points of vector control action - an important principle for IVM.

Vector control and entomology capacities primarily exist at the central level and located in specialized agencies such as the Malaria Research Training Center. The districts have very limited technical capacities for vector control. There are no concrete institutional mechanisms to mobilize the technical capacities in these specialized agencies effectively, in order to support routine vector control operations of the National Malaria control program more proactively. The VCNA reveals a pressing need to strengthen both technical and infrastructure capacities at all levels (national through to the sub-district), and a careful assessment of the placement of these capacities to enable sustainable vector control outcomes and impacts. Clarity in the roles and functions at the various levels will enable cost-effective deployment of staff and cost-sensitive orientation of existing capacities to match national needs for implementing IVM. The national malaria control program requires significant strengthening of its vector control unit, if it is to meet the challenges of assuring effective and sustainable universal coverage of all populations at risk, as currently advocated by the WHO and Roll Back Malaria Partnership. There is a severe shortage of trained personnel across many vector borne disease programs as well.

An Ideal situation will be to mandate, appropriately, a vector control unit within the MOH. The placement of the MOH vector control Unit should be such that will enable it to effectively coordinate, implement, monitor and evaluate vector control activities for VBDs within the Health Sector. A National Intersectoral Steering Committee (NISC) is proposed to coordinate sectoral

efforts, facilitate harmonization of relevant sectoral policies, the development of an overarching national IVM policy, and oversee transition to IVM. NISC should oversee these follow up steps, to translate the conclusions and recommendations of the VCNA into a national IVM strategy:

- Facilitate national review and adoption of the VCNA
- Oversee develop of a national IVM strategy and operational work plans, including transparent mechanisms for broad national consensus and official adoption of the proposed strategy.
- Oversee the implementation, evaluation and documentation of lessons on IVM, to continually improve the efficiency and impact of national vector control efforts.

1 INTRODUCTION

Vector-borne diseases (VBDs) constitute a major public health problem in Mali[1]. The Ministry of Health (MOH) is responsible for the control of all VBDs in the country. Currently, some VBDs are provided more attention than others. Diseases receiving priority attention include malaria, schistosomiasis, onchocerciasis and other blindness-causing diseases transmitted by vectors, lymphatic filariasis, and trypanosomiasis. Very few of the VBDs control programs have developed national plans for vector control and even where they exist, they are not being implemented effectively. There is very little coordination between various VBD programs and opportunities for improving efficiencies through multi-disease approaches are lost.

There are no existing mechanisms for mobilizing intersectoral action. Agriculture and other human activities play an important role in VBDs in Mali. The economy of Mali is 80% based on agriculture (RGHP, 2009). However, the full impact of the impact from agriculture on VBDs is largely not assessed. Current national target of attaining rice production sufficiency, denote a need for close coordination between the agriculture and health sectors to ensure adequate safeguards against the potential negative impacts on VBDs. Diuk-Wasser *et. al.* (2007) found that irrigated rice cultivation increases the production of *Anopheles gambiae*, the primary malaria vector in Mali, and accounted for about 86% of the inter-village variability of vector abundance in August, before the peak in malaria transmission.

The primary vector control interventions for malaria are long lasting insecticidal nets (LLINs) and limited indoor residual spraying (IRS) in select districts. According to a 2010 PMI anaemia and parasitemia study, the proportion of households with at least one LLIN is about 85% and approximately 70% of children under-five years sleep under a net each night. Utilization of LLINs is still low. The VBD programs generally lack adequate numbers of trained human resources in vector control, at all levels of implementation.

[1] Profiles of the major VBSDs in mali are provided in Section 3.3.1

The above scenario indicates a need for an overarching IVM strategy to facilitate national scale up on vector control and maximize impacts on local disease burdens. IVM is defined by WHO as *"a rational decision-making process for the optimal use of resources for vector control"* (WHO, 2008), and is currently recommended as the primary strategy for sustainable and scaled-up control of the vectors of human diseases, including mosquito vectors of malaria. WHO indicates the following central principles for effective implementation of IVM:

- *Advocacy, social mobilization to ensure that IVM principles are embedded in the development policies of all relevant agencies, organizations and civil society.*
- *Appropriate legislative and regulatory framework to effective management and judicious use of public health pesticide.*
- *Institutional framework for effective collaboration by all stakeholders*
- *A rational use of available resources in, including appropriate integration of non-chemical and chemical vector tools and methods and multi-disease control approaches.*
- *Evidence-based decision-making, where vector control strategies and interventions are adapted to local ecology, epidemiology and resources, and guided by operational research and routine monitoring and evaluation.*
- *Development of relevant capacities, including essential physical infrastructure; adequate human resources developed at all levels to manage programs and mobilization of financial resources.*

A first step to developing a realistic national policy framework and implementation strategy for IVM for Mali is to review the current status of vector control in the country. The review should assist the identification of the constraints to the achievement of current national vector control objectives; the gaps and the needs for addressing those problems, as well as the existing opportunities that could be exploited to help address the constraints. Such a process has been defined by WHO as a vector control needs assessment (VCNA) and is the initial step towards the WHO strategic framework of IVM. The VCNA should help to subsequently re-define strategies for moving towards

establishing an efficient, cost-effective and sustainable program, in order to maximize the reduction of mortality and morbidity from VBDs.

1.1 Objectives of the Vector Control Needs Assessment

The objectives of the VCNA were to:

1. Review policy framework and the availability of strategic plans for vector VBDs control programs
2. Review of institutional arrangements and intersectoral collaboration for vector control;
3. Review the control status of VBDs, including planning, implementation and management of operations, gaps and constraints ;
4. Identify opportunities for addressing identified constraints and gaps and use the results of this initial work to develop a national IVM strategy.

1.2 What this report does not cover

This report does not cover the diagnosis, reporting, and case management of VBDs, neither does it provide stepwise instructions on the control or elimination of vector population(s), stepwise instructions on how to resolve existing constraints to vector control, or prescribe roles and responsibilities for different stakeholders. The VCNA is viewed as a first step in a larger process to develop a national framework structured deliberation among national stakeholders sectors to, (i) Adjust national goals and strategies on VBDs, particularly malaria and (ii) develop work plans to address current constraints to national vector control in a more comprehensive and sustainable manner.

2. SITUATION ANALYSIS

This section summarizes existing policies, strategic plans and operational plans for different relevant sectors for a national IVM strategy (i.e. Health, Agriculture, Environment, Trade & Finance and Decentralization). The health section includes a brief introduction to VBDs control programs at the MOH (structures, resources, strategies, constraints, etc.), the most relevant VBDs and their burdens, the national health system (including the communication/information flow), social mobilization and the pesticides management needs and health issues.

This section also reviews the existing constraints to vector control and the opportunities for addressing the constraints or further improving vector management.

2.1. Policy and Institutional Framework for Vector Control

2.1.1. Health sector policies

The national Economic policy -*Projet pour le Developpement Economique et Social* (PDES) - recognizes the importance of vector-borne diseases as a public health problem. Malaria is noted as the primary problem health issue. The 1998 decennial health and social development plan (*PDDS=Plan Décennal de Développement Sanitaire*) of the ministry of health (MoH) has been translated into a strategic program referred to as the Program for Health and Social Development (PRODESS= *Programme de Développement Sanitaire et Social*), which strategy is at its second phase of implementation (PRODESS II). PRODESS II was set to end in 2007 but was extended to 2011. PRODESS III was under elaboration at the time of this VCNA.

The MoH runs a number of distinct/separate national vector control programs for several diseases. These include malaria, schistosomiasis, trypanosomiasis, onchocerciasis, filariasis, dracunculiasis and trachoma[2]. Some of the diseases have detailed national control policies and strategic plans (as reviewed in the following sections), and like Malaria also with separate annual vector control plans.

[2] . In 2007 the Neglected Tropical Diseases (NTDs) program was established to coordinate mass drug administration for schistosomiasis, onchocerciasis, filariasis, dracunculiasis and trachoma. The NTD program however does not include vector control.

There is no overarching national strategy on vector control and opportunities for synergies between disease programs are not adequately harnessed, if at all.

2.1.1.a National Malaria Control Program (NMCP)

The NMCP was created in 1993. However, its legal frame was only effective in 2007 through law Nº07-060, which established it as a department/directorate. There is a national malaria control policy, as well as a related strategic plan, which draw inspiration from the Millennium Development Goals (MDGs) and the 2004 Abuja Declaration on Malaria. The policy has the objective to reduce malaria morbidity and mortality by 50% in 2010 (compared to 2000) and by 80% in 2015 (compared to 2005). To achieve this goal the NMCP has developed the following strategic approaches:

- Prevention
    - Intermittent presumptive treatment in pregnant women (IPTp)
    - Vector Control
- Rapid diagnostic (Microscopy and RDTs) and Treatment (ACTs)
- Epidemics control
- Communication
- Operational research
- Collaboration
- Monitoring and evaluation

The NMCP 2007-2011 strategic plan emphasizes a multi-sectoral and decentralized approach involving all public and private sector stakeholders at all levels (central, district, community). The strategic plan is consistent with the 10-year health and social development plan of 1998-2007, which was extended through phase II until 2011. For vector control, the main interventions are LLINs complemented by IRS in selected districts. The NMCP developed a Technical Note on Malaria in January 2010, which aims at universal coverage of LLINs, through campaigns and other routine distribution routes.

2.1.1b National Onchocerciasis Control Program

Mali was one of eleven countries involved in the Onchocerciasis Control Program (OCP) launched by the World Health Organization in 1974. The OCP closed in 2002 after virtually interrupting the transmission of onchocerciasis in ten of the eleven project countries, including Mali. There is no distinct national policy available at the moment for onchocerciasis control. However, since the closure of OCP, the government of Mali has been committed to preserving the gains achieved, by continuing four activities that are based on the OCP guidelines and which are implemented through annual work plans. The activities are epidemiological surveillance, community-based enhanced treatment by ivermectine, entomological surveillance and Social mobilization.

2.1.1c. National Lymphatic Filariasis Elimination Program (NLFEP)

At the time of this VCNA, the NLFEP had an action Plan (Action Plan for Filariasis control 2007-2011), which was being updated. The main goal of the Plan is to eliminate lymphatic filariasis by 2015. It follows the recommendations of the Global Alliance to Eliminate of Lymphatic Filariasis and has six components - mass drug treatment using Albendazole/Ivermectine (400mg/150µg per kg); epidemiologic and entomologic surveillance; vector control; supervision and training; operational research; information education and communication and; monitoring and evaluation. The vector control measures are based on the use of insecticide-treated materials and sanitation. The plan suggests collaboration with the NMCP, as both filariasis and Malaria are transmitted by the same vectors (*Anopheles gambiae* and *Anopheles funestus*) in Mali. There is very little collaboration between the two programs. Currently, there is neither vector control nor entomologic surveillance activities going on under the filariasis program.

2.1.1d. National Schistosomiasis Control Program

As part of the National program on Neglected Tropical Diseases (NTDs), there are annually developed work plans, which are essentially based on chemotherapy using praziquantel. There is no vector control policy on schistosomiasis. Vector control was conducted in the past but was

discontinued due to excessive cost[3]. A dedicated research Unit at the MRTC conducts research on the schistosomiasis vectors which should be harnessed towards disease control.

2.1.1e National Trypanosomiasis Control Program (NTCP)

There is currently, no national vector control policy and strategic plan for trypanosomiasis, although the control of the disease, which dates back to the colonial era (before 1960) was based on active diagnostic of cases, treatment, follow-up of treated patients and vector control. Vector control measures at the time consisted of reducing human-vector contacts through the use of insecticide-treated traps (usually pyrethroids), aerial and ground spraying of the breeding sites for the tse-tse flies mostly with *Bacillus thuringiensis israelensis*. Due to high cost, vector (Tse-Tse) control activities are meanwhile very limited and linked to the Phase 1 implementation of the African Development Bank supported *Pan-African Trypanosomiasis and Tse-tse Eradication Campaign* (PATTEC). PATTEC was initiated in 2000 by African Heads of states to facilitate to facilitate the elimination of trypanosomiasis in African south of the Sahara. Vector control strategies under the program involve a) use of fixed or mobile insecticide-treated traps and b) aerial and ground spraying followed by the release of insect sterile males. The National Veterinary Department provides trained technicians to conduct the field activities with effective participation of the local communities. These activities are intended to focus on two wide areas: the first is the Basin of the Niger River, including the peri-urban zones of Bamako and extending northeast and southwest (six communes of Bamako and the districts of Kati and Koulikoro) covering an area of 18 000 km^2. The second covers the basin of river Bani (Districts of Baroueli, Segou and Dioila) and extending towards the border with Burkina Faso (Basin of Sourou) - an area of about 19 000 km^2.

3.1.1f. National Division for Public Sanitation and Health (DHPS)

DHPS is the division of the MoH responsible for public sanitation and health. Almost every year the division conducts a larval control campaign in the district of Bamako, with the participation of the

[3] Verbal communication by program officers

local authorities and targeting the control of malaria vectors. Drainage and sewage systems are treated with chemical insecticides during the campaigns. There is however, a need for improved education on the preferred breeding places of *Anopheles* mosquito to enhance the utility of the program on malaria vector control.

2.1.1g. National dracunculiasis eradication program (NDEP)

The NDEP has no national policy per se, but elaborates annual operational plans, based on current WHO's recommendations for dracunculiasis control. The program is headed by a National Coordinator. A national intersectoral Committee (NISC) with the responsibility to:

1. coordinate and provide oversight to the implementation of the national dracunculiasis eradication plan,
2. follow up and control implementations,
3. ensure social mobilization for the eradication of the disease,
4. foster and coordinate stakeholders' actions
5. foster exchanges with other countries with eradication plans of the disease.

2.1.1h. Environmental health policy

Two national policies regulate environmental health issues in Mali: the 1998 national policy for protecting the environment and the 2009 national policy for sanitation. The Sanitation policy recognizes accumulation of rainwater as possible sources of breeding sites for vector-borne diseases. A document on the assessment of the environmental health situation and needs was developed in 2010 as a joint effort between the MoH and the ministry of the environment. This is seen as a follow-up to the Libreville declaration on environmental health in Africa, which Mali ratified in 2008. Based on the environmental health assessment, about fifteen programs and strategies were developed in Mali to better manage the negative impacts of the environment on human health. There are altogether about twenty five laws, decrees, and decisions in the different ministries aimed at addressing issues either on the environment, or human health. However, none of these regulations deal with the specific linkages between the two (ASEB, 2010). Of relevance to

the concept of IVM, is the particular emphasis the different policies make on intersectoral collaboration and associated institutional framework. Efforts are required, to broaden the scope of intersectoral collaboration beyond the MoH and the ministry of the environment, to involve other primary stakeholders such as the departments of Agriculture and Urbanization to further promote reductions of VBD risks.

The ministry of environment also implements the Africa Stockpiles Program (ASP), a multi-country initiative aimed at *"cleaning up and safely disposing of all obsolete pesticide stocks from Africa and Establish preventive measures to avoid future accumulation."* The ASP deals with the obsolete pesticides and their empty containers.

2.1.1i. Social mobilization

The MoH has a communication and mobilization center that was created by law Nº 01 – 033 of 4th June, 2001. The CNIECS (*Centre National d'Information, d'Education et de Communication pour la Santé* or National Center for Information, Communication Education, and Health Communication*)* develops and implements information, Education and Communication, and behavioral change communication (IEC/BCC) plans for health. Its responsibilities include:

I. Coordinate IEC/BCC material production for health,
II. Implement the IEC/BCC for the health sector,
III. Provide technical support to program and departments,
IV. Contribute to the implementation of national campaigns,
V. Diffuse education themes for promoting health, using appropriate media.

The ultimate goal is to achieve an effective social mobilization of the populations for the set public health priorities. The activities of CNIECs, will be a valuable to IVM implementation.

2.1.2. Other relevant sector policies and plans

2.1.2a Agriculture

The ministry of Agriculture regulates the registration, the importation and the use of pesticides in Mali (Law Nº02-014 dated 03-Jun-2002, Decree Nº02-306/P-RM dated 03-Jun-2002 and Ministerial Order Nº02-2669/MAEP-SG). The regulations related to the registration are shared by eight other countries within the CILSS (*Comité permanent Inter-état de lute contre la sécheresse dans le sahel*) through an organ called CSP (*Comité sahelien des pesticides*) which has been functional since 1994. The CSP maintains relations with national pesticide management committees. In Mali, this national committee is under the ministry of Agriculture.

In terms of activities, the ministry of Agriculture has a national agricultural orientation law (Law Nº06-40/AN-RM dated 16-Aug-2006) that covers economic activities of Agriculture. The specific link with the environmental health is not developed. However, within the ministry of Agriculture there are departments that develop, in their annual work plans or campaigns, measures that include vector control directly or indirectly. For example, the office for protecting crops (OPV=*Office de Protection des Végétaux*), the office of locusts control and the rural economic institute (IER=*Institut d'économie rural*) that use pesticides, can be cited. However, in many cases there seem to be an insufficient intersectoral collaboration. Mali's economy is about 80% Agro-based, which very large irrigation system that can have a huge impact on diseases vectors' reproduction. Even though there are timid actions for vector control this needs to be taken to an institutional framework under an intersectoral coordination for the good of an IVM strategy.

2.1.2b. Environment

There is the national policy for protecting the environment and the national policy of sanitation. The ministry of environment is responsible for the environmental impact assessment (EIA) of development projects. The executive organ, National Department of sanitation and control of pollution and nuisances, enforces procedures for environmental impact assessment. It analyzes the

assessment reports and validates them through an intersectoral committee, including the MoH. The Department also audits the environmental impacts of programs and projects during implementation. In addition, it participates in the implementation and monitoring of plans for environmental and social management, in line with Decree N09-211/P-RM of 08 May, 2009.

Procedures for EIA are defined by the ministry of environment through the decree Nº08-346/P-RM dated 26-Jun-2008. The regulation provides a list of the projects that must submit to an EIA. Projects are presented in three categories. While the regulation requires all environmental impacts of implementing a project to be mentioned in the EIA report, there is no specific mention of vector control measures or mitigation. There is, however, mention of parasite control, which could broadly be related to malaria control.

2.1.2c. Decentralization policy

After prolonged national debates on decentralization, Law Nº93-008 was enacted on 11 February, 1993, which defined the administrative organization of the country. Communes (villages in rural areas and "quartiers" in urban setting) were created. There are at total of 761 administrative local councils, made up of 703 communes, 49 districts, 8 regions and 1 administrative area, the Bamako district, with a special statute. In 1999, the first phase of a process of decentralization kicked off – culminating in the development of the national decentralization policy in 2004. This policy involves different levels of decisions making. The central concept is involving the populations or their representatives in setting priorities for the local development and the budgetary programming of territories. The local councils are responsible for developing and implementing their economic and socio-cultural development programs – a so far assumed by the central government. If it is true that the territorial collectivities are autonomous it is also true that the central government has a control mission over their activities. The institutional framework is assured by:

1. 1] the ministry of territorial and local Administration (MATCL=*Ministère de l'Administration Territorial et des Collectivites Locales*),

2. the ministry of civil services, state reform and relationships with Institutions (*Ministère de la Fonction Publique, de la Réforme de l'Etat et des Relations avec les Institutions*),
3. the ministry of planning and territorial development (Ministere du Plan et de l'Aménagement du Territoire),
4. Local Councils (HCC=Haut Conseil des Collectivités)
5. Associations of Local Administration (DCPN 2006).

The decentralization policy is translated into a national program for supporting the Local Administration (PNACT=*Programme National d'Appui aux Collectivites Territoriales*). It consists of a coordination and negotiation framework between the government, the territorial collectivities and the technical and financial partners. The PNACT is in its Phase III which covers the 2010-2014 time frames. This degree of institutional structuring fits well with the decision-making process recommended for the IVM strategy.

2.1.2d. Finance and trade policies related to vector control.

The registration, importation and management of pesticide importation in Mali is regulated by law Nº014 of 03 June, 2003. The law was developed and is applied by the nine member countries that form the CILSS (*Comité permanent Inter-etats pour la Lutte contre la Sècheresse dans le Sahel*). The Sahelian Pesticides Committee (CSP=*Comité Sahelien des Pesticides*) is the common registration organ that assesses all submitted registration dossiers and grants sales permits valid for all its Member States. However, each of the nine CILSS countries has a National Pesticide Management that may assess national applications in case of emergency, or for research purposes, and grants exceptional permits. The law Nº014 stipulates that the custom services, the national directorate of trade and concurrence and the security forces should collaborate to manage the importation/exportation of pesticides. Law N° 01-075 dated 18 July 2001 defines taxes and tariffs on importation, including for pesticides. However, there are specific situation in which government may grant exemptions to the importation of pesticides. In addition for some goods, Mali tends to use standards from sub-regional organizations such as UEMOA (Economic and Monetary Union of West Africa/*Union Economique et Monetaire de l'Afrique de l'Ouest*) and ECOWAS (Economic

Community of West African States/CEDEAO=*Communauté Economique des Etats de l'Afrique de l'Ouest*).

2.2. Structure, resources and functions

2.2.1. Within the health sector

2.2.1a. Structure

The MoH does not have a unified vector control unit; the VBDs control units are organized into programs that develop their own intervention plans, although there has been some limited attempt at collaboration between some units (see section 3.2.1.2.). The NMCP was established as a Directorate in 2007 with direct reporting to the Secretary-General of MOH. It is led by a director, while the other programs are led by coordinators under the authorities of the national director of Health (DNS). The mobilization center (CNIECS), as the NMCP is under the secretary general (see fig 1).

Currently, the VBDs control programs at the DNS are:

- Trypanosmiasis control program,
- Schistosomiasis and earth worms control program,
- Dracunculosis control program,
- Lymphatic filariasis elimination program,
- Onchocerciasis control program,
- Blindness control program (includes Trachoma).

In addition to the VBDs programs, there are control programs for other important diseases such as tuberculosis, leprosy and HIV/AIDS etc.

In 1990, the Government of Mali adopted the decentralization policy for health and populations. The policy essentially seeks to decentralize health care and the participation of communities. It aims to extend health care services. and guarantee access to drugs for all the populations. Regional

health districts were given the autonomy to plan and implement activities with the districts, commune and primary health care center (CSCOM)

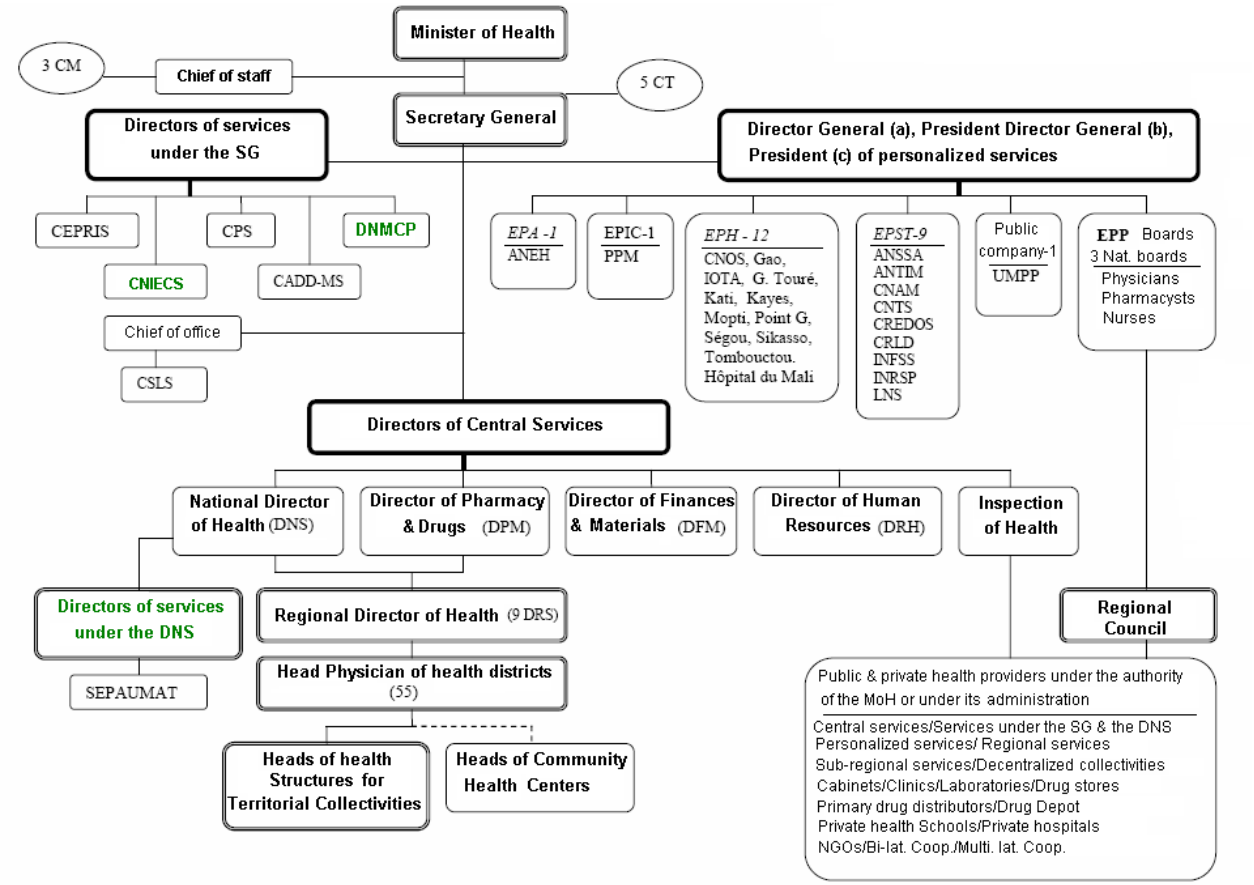


Figure 1 Organization of the MoH

The health system in Mali is organized into three levels ((See SNIS 2009):

- *A central/national level* – There are 5 national public hospitals (EPH) and a Mother and Child Hospital, represents the third level of referral; it develops plans, brings strategic support, evaluates, mobilizes resources and makes decisions.

- *Intermediary/regional level* – There are 7 regional public hospitals (EPH), which serve as second level of referral and bring technical support to the lower operational level.

  The central and regional referral level hospitals are under the supervision of the MOH's Particular Services Department.

- *Operational level* – supports planning, organization, implementation and monitoring & evaluations of plans and programs. There are two sub-levels which are administered by the Regional Directorate of Health (*Direction Régionale de la Santé*):

  - *Community and primary health centers* (CSCOM) There are currently 993 CSCOMs. The CSCOMs are the primary level of health care service in the country and form the first point of contact for the sick. The center offer a "minimum activity package" (PMA=*Paquet Minimum d'Activité*). The PMA consists of curative, preventive (reproduction health, child health, immunization) and promotional cares. They provide care for sexually transmitted infections and are involved in HIV control, etc.; normally cases from the community health center get referred to the CSRef. Although there is a high level of self-reporting at the CSRefs and even to directly to the hospitals.

  - *Referral health centers* (CsRéf = Centre de Santé de Réference) are the second level of health care in the country and considered the first level of referral in the district. There are currently 59 such centers across the country. These fall under the supervision of the local administration (Mayor).

2.2.1b. Integration among disease control programs

Following WHO recommendations, the MoH has initiated an integration scheme for a number of neglected tropical diseases (NTDs) including filariasis, schistosomiasis & geo-helminthiasis, onchocerciasis, and trachoma. The MoH organizes yearly national campaigns for the NTDs. The campaigns are based on chemotherapy. The vector control aspect has not been developed. There are indications that a national plan is under development and will include additional neglected

diseases. NLFEP has drafted a plan that seeks to integrate other additional neglected diseases, including malaria. However, this has not yet been translated into action. These draft plans provide a window of opportunity on which a national IVM approach could certainly consolidate.

2.2.1c. Communication and information flow

Communication and information flow with the MOH, consist of three organizational levels: local, regional or intermediary and national.

Local level

At the primary/Community health center (CSCOM) level, information is collected and recorded in hard copies and transmitted to the second sub-level (district/CsRef) in the form of quarterly activities report (RTA=*Rapport Trimestriel d'Activités*). At the district level, the information is recorded electronically (currently utilizing the DESAM software c), checked for completeness and accuracy. It is then analyzed and transmitted to the regional/intermediary level, in both hard and soft copies (removable disks, E-mails). Feedback is sent back to the lower levels, including highlighting and discrepancies between the hard copy reports and the district electronically recorded versions.

Regional/Intermediary level

The regional directorate of health (DRS=*Direction régionale de la santé*) updates tables, checks data for completeness and accuracy, analyzes and interprets results in order to inform the decision-making process. The directorate then sends hard copy of the quarterly report (RTA) and a soft copy of tables to the National Directorate of Health (DNS). It sends a feedback to the CsRefs about any observed differences between the hard and the soft copies.

National level

Tables received from the intermediary level are checked, analyzed in DESAM and interpreted. The quarterly reports (RTA) are archived at the local health information system, SLIS (*Système Local d'Information Sanitaire*). Other statistical softwares (Epi_Info, Health Mapper etc.) are used at that level for data analysis. The information is assembled and used for decision-making.

A feedback is sent to the regional directorate of health (DRS) and CsRefs before transmitting reports to the sector planning commission (CPS=*Cellule de Planification Sectorielle*), to the minister's staff and to partners.

2.2.1d. Human Resources, including functions and authority with MoH

There is currently no substantive vector control unit and vector borne disease control programs are characterized by an insufficient number of staff members and qualified personnel. The national NMCP is the most advanced in terms of plan conception, planning, resource mobilization, implementation and monitoring/evaluation. However, the Program faces an extreme need for qualified personnel for vector control. Although the malaria program is the largest of the VBDs control programs with 53 staff members, there is currently only one staff with some training in entomology. The program does not have a substantive vector control unit. The Table 1 shows the number of staff members in the VBDs control programs. The VBD programs are all under the National Director of Health (DNS) (ref: Fig. 1, section 3.2.1.1)

Table 1 Staffing levels of vector borne diseases control programs (2011)

Programs	Current staffing/office	Field staff
Malaria Control program	53	Focal points
Shistosomiasis control program	3	-
Filariasis elimination program	3	-
Onchocerciasis control program	3	-
Trypanosomiasis control program	2	-
Dracunculiasis control program	9	42 (35 heath zone agents + 7 physicians) + 800 volunteer workers
Total	73	

2.2.1f. Infrastructure (including training, research and technical facilities)

Health facilities

The Table 2 shows the distribution of health infrastructures in Mali. As reviewed in Section 3.2.1.4, there are 7 hospitals (4 in Bamako and 1 in each of 7 out of 8 regions), 59 district health centers and 993 CSCOMs. Table 2 provides the distribution of health infrastructure in the regions (SNIS 2009).

***Research in entomology/vector control*:**

There are two renowned research outfits in Mali, both operating under the University of Bamako.

- *Malaria Research and Training Center (MRTC)* : The International Center for Excellence in Research (ICER), located at the Faculty of Medicine, Pharmacy and Dentistry (FMPOS: *Faculté de Médecine, Pharmacie et d'Odonto-Stomatologie*) of the University of Bamako. ICER has a Malaria Research and Training Center (MRTC) and a Tuberculosis/HIV Research and Training Center (SEREFO). MRTC has two independent departments in entomology and parasitology, which routinely undertake research and provide training, and technical support in entomology.

Table 2 Public and private health Infrastructures in Mali in 2009 (Modified from SNIS 2009)

Regions / Infrastructures	Kayes	Koulikoro	Sikasso	Ségou	Mopti	Gao	Tombouctou	Kidal	Bamako	Total
Public hospitals	1	1	1	1	1	1	1	0	4	11
Private Hospitals	1	0	0	0	0	0	0	0	2	3
CSREF	7	9	8	8	8	5	4	4	6	59
Medical clinics	5	3	5	2	2	1	0	0	37	55
Surgery clinics	0	0	0	0	0	0	0	0	11	11
Medico-surgery clinics	1	0	0	0	0	0	0	0	3	4
Birth Clinics	0	0	0	0	0	0	0	0	3	3
polyclinics	0	0	1	0	0	0	1	1	3	6
Consultation clinics	10	9	15	7	3	2	0	0	83	129
Care clinics	14	12	20	12	11	2	1	0	51	123
Dental clinics	1	0	1	0	0	0	0	0	13	15
CSCOM	167	156	188	165	134	67	55	9	52	993
Total	207	190	239	195	159	78	62	14	268	1412

The Entomologic department of MRTC, carries out basic and operational research on the control of the vectors of VBDs. MRTC works in collaboration with the MoH – providing and other government agencies according to their needs. Specifically, the Center provides technical supports to the NMCP, the NFLEP among others. Although the name of the Center refers to malaria research, MRTC has qualified personnel with higher education (PhDs and Masters) with competencies in other VBDs, and has research facilities for lymphatic filariasis, leishmaniasis and tick-borne fevers. The entomology Division of MRTC has 8 well equipped laboratories, which meet international standards, as well as three insectaries where malaria/filariasis and leishmaniasis vectors are currently reared. There are information technology services capable of accommodating over 200 computers. The internet connection is provided through a V-SAT.

The focus of current basic research at MRC includes:

- malaria vector mating behavior and ecology,
- malaria vector populations genetic structures,
- insecticide resistance detection in malaria vectors,
- gene expression profiles in malaria vector associated with blood feeding and parasite infection,
- developing transgenic malaria vectors *in situ*,
- epidemiological and immunological investigations on lymphatic filariasis (LF),
- treatment regimens for LF and impact on transmission,
- epidemiology of leishmaniasis, incriminating the vectors and vaccine development
- epidemiology of tick-borne relapsing fevers (TBRF), incriminating vectors and assessing the distribution of the disease and
- predicting malaria risks using GIS/remote sensing.

The current operational research includes:

- baseline entomologic surveys in linked to IRS, including insecticide resistance assays

- assessing gaps in current vector control strategies and identifying and optimizing new combinations,
- assessing the added values of larviciding to IRS for malaria control,
- entomologic monitoring of IRS,
- development of a dry-season vector control strategies and
- assessing the intrinsic efficacy of durable wall lining in rural setting.

MRTC has 20+ years of collaboration with the National Institutes of Health of the United States of America (USA). In addition, it collaborates with several universities in Africa, USA and Europe. The center collaborates with the World Health Organization on various research areas. These collaborations result in joint research with all parties fully involved under administrative agreements. MRTC also provides entomological evaluation services linked to the Indoor residual operations supported by PMI (US President's Malaria Initiative).

The Applied Molecular Biology Laboratory (LBMA): LBMA is located at the Faculty of Science and Techniques (FAST) of the University of Bamako. It also conducts vector control research. The current objectives of LBMA include 1] assessing the impact of larvicides on malaria vectors and *Culex spp* and 2] assessing the impact of vector control strategies on malaria transmission in areas where the Millenium Villages Project operates. As with MRTC, the administrative agreements are made with the university of Bamako.

Through the university, the government provides utilities and the administrative and institutional framework to these two primary research organizations. The allocated budgets for vector control research are provided by either partners or competitive research grants, denoting the longer-term vulnerability of these research activities.

Training linked to vector control.

The University of Bamako offers a degree course in entomology/parasitology (2-4 years after high school) referred to as DEA (*Diplôme d'Etude Approfondie*). This is an academic training on general entomology with no focus on any single disease.

MRTC provides training on malaria and filariasis vector biology and control strategies. This is a short, non-degree awarding course (from a few weeks up to six months and over) which are organized based on needs and resources. The NMCP, with the support of partners such as WHO and PMI, organizes training sessions on entomology under the auspices of MRTC.

2.2.1g Financial resources

The bulk of the budgetary allocation to vector control in Mali is by external developmental partners such as the Global Fund on HIV/AIDs TB and Malaria (GFATM) and PMI. The scenarios put in doubt the sustainability of national vector control strategies and actions. Most VBDs control program do not have vector control plans, the few, like malaria, that do lack the financial resources to meet their goals and implement their strategies without external aid. There is a growing demand to integrate vector borne disease implementation, as evidence by the establishment of the NTD program in 2007, although it is mainly on mass drug administration. It is believed that such integrated approaches provide better prospects for maximal use of limited resources through increased efficiencies. Within this context, the proposal to develop a national IVM policy and strategic framework provide a more excellent opportunity to realize the goals of integration.

2.2.2. Relevant structure and resources in other sectors

The ministries of Agriculture, Environment and Territorial Administration constitute important stakeholders for a successful IVM strategy in Mali. Other potential stakeholders include the National Department of Veterinary Services as they are involved in animal pests control hence use pesticides; as well as the ministry of higher education and scientific research with its research laboratories at the University could provide opportunities for training and operational research relevant to vector control.

2.3. Vector control planning and implementation

The Section reviews the how vector control is planed and implement. The major VDBs are reviewed together with the major vector control interventions in use. Other areas discussed are capacities for pesticide management, collaboration between VDB and related programs/departments within the health sector,as well as the staus of collaboration between sectors and stakeholders, behavior communication and community mobilization

2.3.1. Major Vector Borne Diseases: Burden, Distribution and Vectors

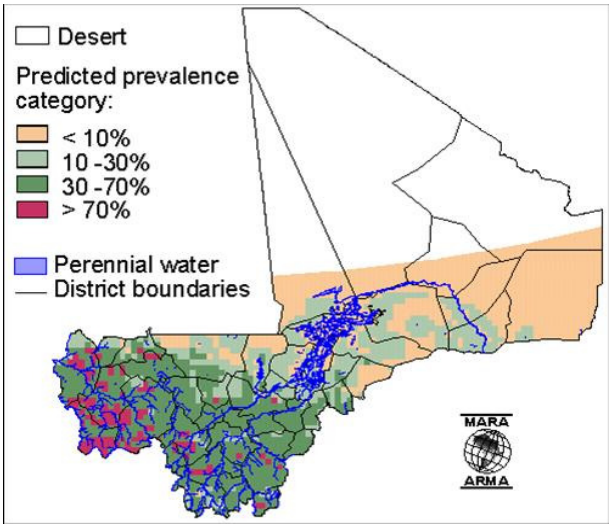
2.3.1a. Malaria

Malaria still remains a major public health concern in Mali with 1 633 423 cases and 2 331 deaths (SNIS, 2009). The disease accounts for 37% of all causes of medical consultations (NMCP 2009) Pregnant women and children under five constitute the most vulnerable groups. About 95% of the malaria cases are due to *Plasmodium falciparum*, *P. malaria*e and *P. ova*le, *P. vivax* is suspected in the north of the country. Malaria transmission is endemic to the southern and central areas of the country – areas inhabited by close to 90% of the country's population. Malaria transmission is epidemic in the north of the country with drier and desert climate. Malaria cases tend to peak in the rainy season along with a peaking of vector densities (Toure *et. al.* 1998) with a peak in October/November. However, a second transmission peak occurs in regions where agricultural irrigation is practiced. Prevalence declines from the southern humid zones to the northern arid zones (Table 3 & Fig. 2).

Table 3: Types of malaria transmission in Mali

Transmission type	Geographic areas	Additional comment
Year round	Sudano-Guinean in the south of Country	Seasonal peaks (June –November)
Low but endemic	Niger River Delta, areas near dams and rice cultivation; urban areas (e.g. Bamako, Mopti)	Year round
Short transmission	Sahelian Zone in north of country	3-4 month/year (July - October)
Epidemic	• Dry northern Regions: Tombouctou, Gao, and Kidal • Northern districts of following regions: of Kayes, Koulikoro, Segou and Mopti Regions)	Timing of epidemic uncertain

The major malaria vectors in Mali are the complexes *Anopheles gambiae s.l. and Anopheles funestus* (Toure et al, 1982). Within the complex *An. gambiae s.l.* two species are found in Mali: *An. gambiae s.s.* and *An. arabiensis*. Three chromosomal forms of *Anopheles gambiae s.s.* have been described. They are referred to as Mopti, Bamako and Savanna (Toure et al, 1998). Both molecular forms (M and S) are encountered.



2.3.1b. Schistosomiasis

Mali was among the first countries in Africa South of the Sahara, to initiate a national schistosomiasis control. Control activities began in 1978. In 1982, a substantive program was established under the MOH, with the financial support from the German International Cooperation Agency (GTZ). GTZ supports ended in 1992 and control activities then gradually came to a halt by 1998, due to lack of financial resources. The disease then rebounded until 2004 when external funding began again from Bill and Melinda Gates Foundation, through the Schistosomiasis Control Initiative. (Clement at. al., 2009). SCI support continued through 2008. Gates and USAID supported NTD program rolled in from about 2005. Disease control is still based on chemotherapy (Praziquantel and albendazole) with a particular focus on school children. Currently, there is no vector control or entomologic surveillance activity in the country.

Evidence shows that the current disease burden is equal to the period of no control after the exit of GTZ and the start of SCI support in 2004. SNIS (2009) reports a survey in eight villages in the Baguineda rice irrigation area, which showed a prevalence rate of Schistosomiasis at 37.8% (n=497) for urinary schistosomiasis and 62.8% (n=438) for intestinal schistosomiasis. The parasites in Mali are *Schistosoma haematobium* (urinary) and *S. mansoni* (intestinal). These reported figures were higher than model-predicted prevalence obtained in earlier studies that showed a prevalence rate

of 25.7% in 1984-1989 and 38.3% in 2004-2006 for S. haematobium. The prevalence rates of S. mansoni during the same study periods were 7.4% and 6.7% respectively. Figs. 3&4 show the prevalence rates at the indicated periods in two subject groups (villages and school children). Clements *et al.,(2009)* did not find significant differences between prevalence of both *S. haematobium* and *S. mansoni* in the two time periods (1984-1989 & 2004-2006).

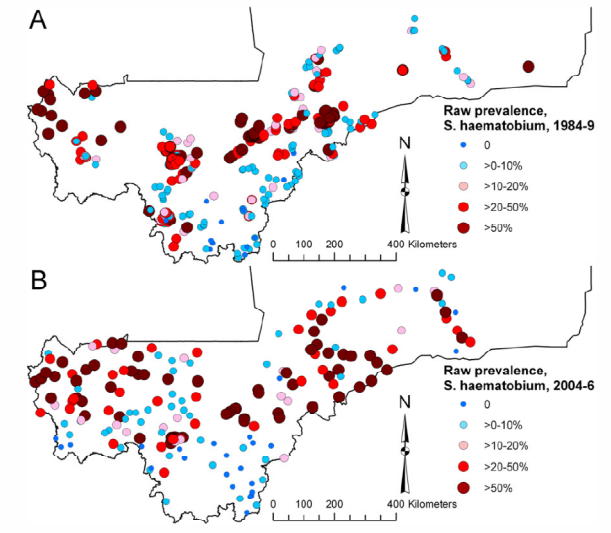


Figure 3 Raw prevalence of *Schistosoma haematobium* infection (A) in 1984–1989, in 300 villages and (B) in 2004–2006, in 194 schools, Mali, West Africa (Clements et al, 2009)

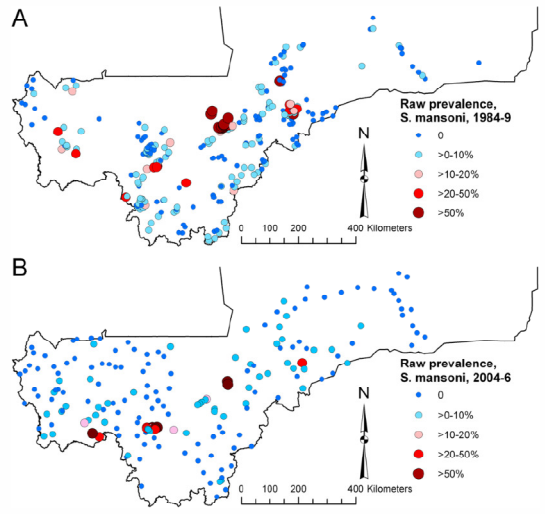


Figure 4 Raw prevalence of *Schistosoma mansoni* infection (A) in 1984–1989, in 300 villages and (B) in 2004–2006, in 194 schools,
Mali, West Africa

2.3.1c. Lymphatic filariasis

A 2007 NLFEP report (SLIS 2007) indicated a prevalence rate for Lymphatic filariasis (LF) of 7.07% in Mali. The entire population of the country is at risk. Fig. 5 shows the distribution of LF in Mali, as at 2007. Currently, disease control measures are based on mass drug treatment using a combination of ivermectin and albendazol, surgery for

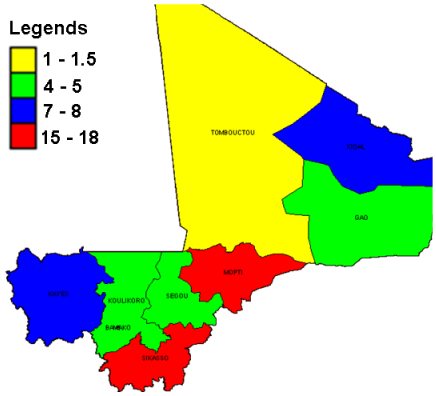


Figure 5 Prevalences of LF in Mali, based on ICT (NFLEP, 2007)

hydrocele and ectopic treatment for elephantiasis. The strategy aims at morbidity control.

LF is transmitted by the same vectors as malaria: the complexes *An. gambiae s.l.* and *An. funestus s.l.* The role of the *Culex spp* has not been investigated. The initiation of IVM will therefore, directly benefit LF program as it will enhance opportunities for multidiseas approaches targeting malaria and LF.

2.3.1d. Onchocerciasis

Mali is one of the 11 countries where the Onchocerciasis Control Program (OCP) was implemented under the auspices of the WHO. Currently, the MoH conducts epidemiologic and entomologic surveillance of onchocerciasis in 45 villages. A 2009 SNIS report indicates that the last epidemiologic surveillance did not detect infection among 6,596 human subjects examined. In addition, the annual entomologic surveillance, in which 60 000 black flies were examined from a collection of 205 072, none was found infected with *Simulium damnosum,* the primary vector in Mali. This does not necessarily mean that the country is free of the disease. A multi-countries surveillance showed a prevalence < 5% in Mali (see fig 6). This is the threshold set by WHO.

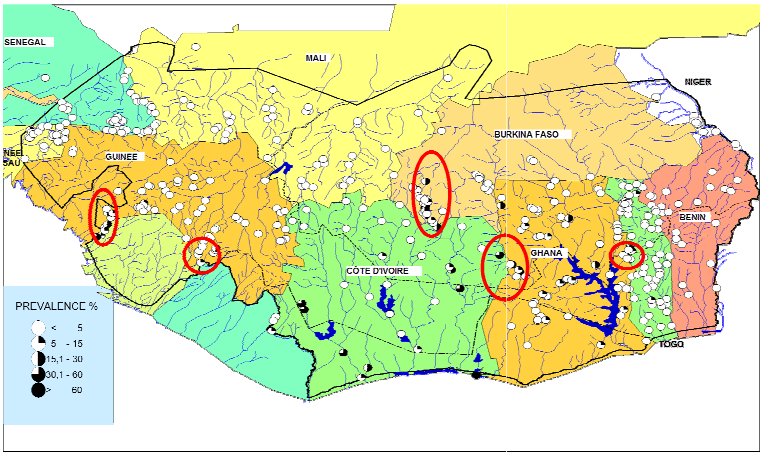


Figure 6 Current Situation of the onchocerciasis infection in the OCP countries in 2010 (PNLO, 2011)

There are four main ongoing activities by the National Onchocerciasis Program:

1. Strengthen treatment by ivermectine under communities' directives,
2. Epidemiological surveillance,
3. Entomological surveillance and
4. Social mobilization.

Surveillances continue to show prevalence rates of less than 5%.

The entomological surveillance is based on fly collections once a year. The collected vectors are pooled and sent to Burkina Faso for detecting the infection. No vector control measure is implemented. Up until 1987, vector control was the exclusive control measure under the OCP program. It involved spraying of insecticides by helicopters and aircrafts targeting blackflies' breeding sites (aerial larviciding). In 1987, mass drug administration (MDA) by ivermectin was added to larviciding, under a community-based distribution framework. The current coverage rate for the MDA is 78-80% (SNIS, 2009).

2.3.1e. Dracunculiasis

In 2009, 186 cases were reported, among which 133 (72%) were from 7 districts in 5 regions (SLIS 2009). According to the morbidity and mortality weekly report (MMWR) from CDC, this represents a 55% reduction compared to figures obtained in 2008 where the number of reported cases was 417. However, when we consider the reported number in 2007, which was 313 (Hopkins et al 2008, WHO 2009), we observe an increase in 2008 and then a decrease in 2009. This might indicate a cyclic fluctuation in the infection. *Dracunculus medinensis* is the parasite, and the vectors are copepods encountered in stagnant waters. Figure 7 shows the endemicity level in 2009.

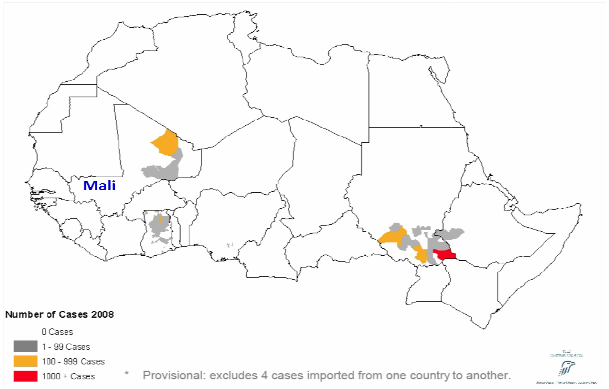


Figure 7 Distribution of 3,972 Reported Cases of Dracunculiasis Jan-Aug 2008 (Source: Modified from Ernesto Ruiz-Tiben, president of the Carter Center)

Despite control efforts from several initiatives and supports (The 1986 World Health Assembly initiative to eradicate dracunculiasis from 20 countries, including Mali, the 1993 assistance from Global 2000, Inc., and the WHO Collaborating Center for Research, Training, and Eradication of Dracunculiasis at CDC, the eradication effort through Carter Center) Mali still remains endemic for the guinea worm disease (GWD) mostly in the northeast of the country.

2.3.1f. African trypanosomiasis

Focal studies in 2005 (Dao et al, 2005) showed that the human African trypanosomiasis was no longer a public health issue in Mali. WHO also indicated that Mali has not reported new cases for over a decade (WHO, 2010). However, all the conditions are present in the country for a re-emergence of the disease. Three vectors have been described in Mali: *Glossina morsitans submorsitans*, G. *palpalis gambiensis* and *G. tachinoides.*

The National Trypasonosomiasis Control Program (NTCP) envisages conducting active epidemiological and entomological surveillance in collaboration with other relevant health units. A strategy on this is to be developed by the NTCP to guide implementation. Mali is part of Pan-African Tse-tse and Trypanosomiasis Eliminiation Campaign (PTTEC). The overall objective of PATTEC is to create zones in the six countries (Mali, Uganda, Kenya, Ghana, Ethiopia and Burkina Faso) that are sustainably free of trypanosomiases and tse-tse flies. It uses the area-wide approach which aims at covering large areas that are infected by tse-tse flies. That contributes to the effort of elimination of the trypanosomiasis from Sub-Saharan Africa. PATTEC operations in Mali are briefly described in Section 3.1.1.5). Vector control strategies used are (i) use of fixed and mobile insecticide-treated traps, and (ii) aerial and ground spray followed by the release of insect sterile males. The National Veterinary Department provides technicians to conduct the ground work with effective participation of the local communities.

2.3.1g. Other vector borne diseases

Other vector borne diseases exist in Mali but are either under-investigated or not well known. Fortunately there are research programs that are interested in some of these diseases. Therefore, some limited amount of basic information is available for a few of the diseases. MRTC conducted basic epidemiologic studies on leishmaniasis, tick borne relapsing fevers (TBRFs) and dengue.

Leishmaniasis

The first reported case of leismaniasis in Mali dates back to 1948. In the 1960s about 600 cases were reported from six different regions almost covering the range of the country (Paz et al, 2011). In 2003 Keita et al. reported 251 cases working at the CNAM (*Centre National d'Appui à la lutte contre la Maladie*). These studies and recent results from studies at MRTC, in collaboration with NIH/NIAID/LMVR have shown that cutaneous leishmaniasis is one of the three forms of leishmaniasis (Visceral and muco-cutaneaous being the two others) encountered in Mali. The parasite is *Leishmania major* and *Phlebotomus duboscqi* is believed to be the vector. Scientists are working to confirm and document this. Currently, there is very little information on the epidemiology of the vectors (Paz et al, 2011).

Tick Borne Relapsing Fevers *(TBRFs)*

Active research activities are going on at MRTC through the acarology unit, to investigate the epidemiology of TBRFs in the country. Preliminary data to date show evidence of TBRF-infected rodents. Investigations using sera also has shown past exposure of humans to TBRFs. In addition, the incriminated tick (*Ornithodorus crocidurae*) was found in Mali (MRTC *unpublished data*). *Borrelia corcidurae* is the causative agent of TBRF in West Africa. Investigations are ongoing to collect more eco-epidmiological data on TBRFs.

Dengue

Little is known on dengue in Mali. Recent documents report cases of circulating DENV II in Mali (Anonymous-b in Franco *et. al.*, 2010). In a recent study conducted by MRTC, the national institute for research in public health (INRSP=Institut National de Recherche en Santé Publique) and CDC on archived human sera showed that DENV I and II are circulating in Mali (Phoutrides *et. al.,* In press). Dengue is transmitted by *Aedes spp*, which is present in Mali.

2.3.2. Tools, Methods, Strategies and Coverage

2.3.2a. LLINS

The national malaria strategic plan has an objective of universal coverage of all at-risk population with LLIN by 2014. The target is to provide one LLIN for every two people. The mode of distribution is mainly by mass distribution campaigns to households, and through antenatal care (routine distribution channel), as well as the clinics linked to the Expanded Program for Immunizations (EPI) for women and children. A 2010 malaria survey during the peak transmission season showed that 85% of households owned an ITN and 93% of households owned at least one mosquito net. Between 2006 and 2009 more than 6 million ITNs were distributed (Presentation DPNLP, 2011). Following the adoption of the universal coverage policy[4], Mali has been conducting a phased distribution of LLINs, initially targeting the most vulnerable groups (pregnant women and children under five). Initial estimates indicated 8.67 million LLINs will be needed to cover a population of 15.6 million. By June 2012, more than 3.9 million LLINs had been distributed in five out of the nine regions in the country. Of this number, PMI provided more than 3.48 million LLINs for distribution in three regions - Sikasso, Segou and Mopti. The developmental partners of Mali have been supporting with significant LLIN procurement and support for distribution. There are also ongoing efforts to strengthen the distribution infrastructure.

There are significant efforts towards strengthen the LLIN distribution systems all levels. Efforts have included training on inventory and related reporting to ensure timely information and prevent stock outs.

The NMCP, in collaboration with partners, has revamped information, education, communication/ behavior change communication (IEC/BCC) activities at all levels, to promote LLIN utilization among target. With regards to the implementation of a future national IVM strategy, the national information and communication center for health will be a valuable stakeholder.

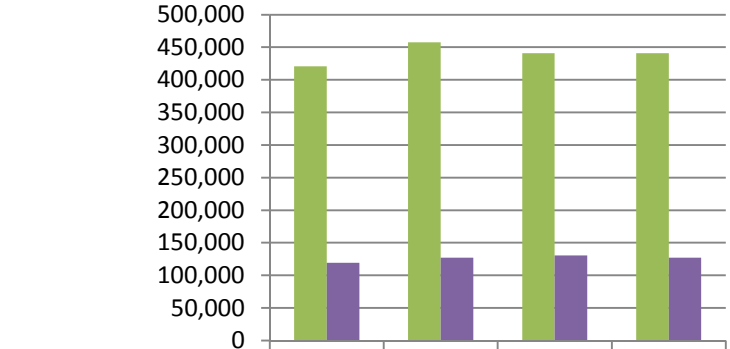
[4] Mali Universal coverage target is one LLIN for two persons

2.3.2b. Indoors Residual Spraying

IRS is the second of the two major malaria vector control interventions currently being deployed in Mali – the first being LLINs. The intervention has been conducted in two districts (Bla and Koulikoro) since 2008 using pryrethroids (lambda-cyhalothrin and deltamethrin) for malaria vector control. In 2011, a third district (Baraoueli) was added. Figure 8 provides the number of households coverage in each year from 2008 to 2011, and the corresponding populations provided protection (PMI 2011; RTI 2008, 2009, 2010). The acceptance rates for IRS have been high; 90.3% in 2008 and 97% in 2011. PMI is providing financial and technical support to the IRS operation. It is also working closely with MOH to strengthen country capacity to plan and supervise IRS activities, with various targeted training. A national IRS strategy is under development to scale-up cost-effective operations within a broader context of integrated vector management.

Entomological surveillance linked to IRS operations, is carried out by MRTC under the auspices of the NMCP. The following indicators are routinely measured to inform implementation decisions: residual efficacy of treated walls using WHO cone bio-assays (CBA), vector species (including molecular forms) and densities, human biting rates, human blood index, *Plasmodium* sporozoites infection rates, vector biting rates and entomologic inoculation rates (EIRs). The insecticide resistance/susceptibility level is also assessed through bio-assays and molecular means when possible.

Fig. 8: IRS Coverage 2008-2011



	2008	2009	2010	2011
Population protected	420,580	457,374	440,815	440,815
Households sprayed	119,194	126,922	130,842	127,273

Insecticide resistance and IRS: IRS intervention in Mali, as in most parts of West Africa, is challenged by the presence of insecticide resistance amongst the local vector populations. The detection of resistance to pyrethroids and to DDT in both IRS areas and non-IRS area denote an urgent need to institute a resistance management scheme. For some areas, the detection of pyrethroid resistance after just three years of spraying, has led to a decision to switch from pyrethroids to a different class of insecticide in the 2012 round of spraying.

Private sector IRS operation: Some private organizations and/or companies conduct focal IRS operations to control malaria. However, standardized best practices are not followed and there are no credible enforcement procedures to ensure that these standards are strictly adhered to. The situation is not ideal, as non-judicious use or sub-standard implementation of IRS can accelerate the development of vector resistance and risk the long term utility of IRS insecticides. If the national targets for IRS are to be achieved and sustained, the contribution private sector is crucial. Contribution from the sector could either be directly to efforts by the MOH or as corporate social responsibility initiatives where companies establish their own programs. Such private endeavors must be properly supervised. It is important that a future national IVM strategy adequately considers how the private sector IRS operations are adequately supervised to ensure maximal compliance.

2.3.2c. Larviciding

An operational research project on larviciding was conducted in the Koulikoro region by MTRC in 2009 and 2010, to assess the added value of larviciding on IRS in the local eco-epidemiological setting. Results showed a considerable reduction in the densities of late stage Anopheles larvae. However, the impact on transmission of malaria was not clear. It is noted that only larviciding was used, and not a broader larval source management (LSM), which would normally include additional options such as drainage, breeding site elimination, etc. Although the NMCP envisages conducting larviciding as a complementary vector control intervention in appropriate locals, there are currently no formal larviciding activities by MOH. The national department for public health and sanitation (DHPS), however, conducts annual campaigns of larval control against malaria in the Bamako district using chemical insecticides. Due to the lack of information, these operations often target sites that are not the preferred breeding sites for malaria vectors denoting a need to provide information, and training to such efforts by local administrations. Overall, there will be a need for proper evaluation of the cost-effectiveness of the broader LSM, before significant national invests are made into the intervention. This will ensure maximal complementary benefits.

2.3.2d. Insecticide treated screens or traps

Screens are installed in targeted areas by PATTEC (see section 3.1.1.5) for the control of *Glossina* vectors of trypanosomiasis. The project is ongoing. The areas covered have been previously described Section 2.1.1e. IEC/BCC plays a tremendous role in the control efforts, in both disseminating information and education on the disease to the communities but also to prevent people from taking down the screens and using the materials for other purposes.

2.3.3. Pesticides Management Needs, Safety and Environmental Issues

The major challenges identified from the review of ongoing VBDs control:

i. *Absence of national expertise and equipment to assess the quality of pesticide formulations*
ii. *Inadequate reinforcement of the regulations on pesticides importation*

iii. *Registration system based on brands instead of generic names as conducted by WHO*

iv. *Insufficient capacity of pesticide management (storage, transport, waste management, and sound disposal)*

v. *Absence of a certification scheme for public health pesticide application equipment*

The pesticides, including those used in public health, are regulated by the ministries of Agriculture and Environment. The Ministry of Agriculture holds the mandate for registration, licensing and importation. The processes are done under the auspices of the CSP (*Comité sahelien des pesticides or Sahelien Committee on Pesticides*),which is the executive organ of CILSS[5] the intergovernmental body for pesticides registration in the nine countries members. (ref: Section 3.1.2.1.).

The Ministry of Environment Safety and environmental, on the other hand, is responsible for compliance issued relating to environmental impact assessment, waste management, disposal of pesticide, and management of pesticide stockpiles (see section 3.1.2.2.). The ministry of Environment is supported by a Pan-African Stockpiles Program (PASP), supports the Ministry of Environment with waste management, the stockpiles, containers, etc.

Normally, pesticide registration and license are obtained for a limited period of time. The CSP publishes the updated list of registered pesticides. The government maintains the privilege to authorize exceptions in cases of emergency. Table 3 shows the main pesticides that are currently registered used in vector (mainly mosquitoes) control and or research. This list is by no means exhaustive.

The Ministry of Environment works with the Customs Services to control pesticides importation. However, Mali is a very large country which shares borders with seven other countries. This makes adequate policing of pesticide entries on the territories a very challenging undertaken. The national

[5] *Comité permanent Inter-état de lute contre la sécheresse dans le sahel*

department of trade and concurrence (DNCC) also has a role in controlling importation, as it holds the mandate to regulate international trade.

Table 3 Pesticides currently authorized for vector control and/or research in Mali

Pesticides	Class	Interventions
Permethrin	Pyrethroid	ITNs
Deltamethrin	Pyrethroid	ITN, IRS
Lambda-cyhalothrin	Pyrethroid	IRS
Cyfluthrin	Pyrethroid	Indoor and outdoor spraying
Cypermethrin	Pyrethroid	Indoor and outdoor spraying
Malathion	Organophosphate	IRS
Temephos	Organophosphate	Larviciding
Diazinon ULV	Organophosphate	Indoor and outdoor spraying
Chlorpyirifos	Organophosphate	Indoor and outdoor spraying
Bendiocarb	Carbamate	Indoor and outdoor spraying
Propoxur	Carbamate	Indoor and outdoor spraying
Diflubenzuron	Hormone regulators	Larviciding
Bacillus thuringiensis israelensis (Bti)	Bio-pesticide	Larviciding
Bacillus sphaericus	Bio-pesticide	Larviciding

- The National Laboratory of Health (LNS) - monitors the quality of food, drugs and drinking water. The quality control unit has about nine staff members.
- The national laboratory for water control (LNE=Laboratoire National de l'Eau) - monitors the quality of all types of water bodies by determining their physical, chemical and bacteriological characteristics.
- The national veterinary laboratory (LCV) - has a toxicology and quality control unit that has the expertise to assess the chemical residue of pesticides in the soil. The LCV's toxicology unit has about ten staff members.

Both LNS and LCV have the expertise and the equipment to perform chemical residue analyses. However, the availability of reference substances haa always been a common constraint limiting the performance of the two laboratories. All the laboratories are located in Bamako.

2.3.4. Intra/Inter-sectoral collaboration

Control of all the major VBDs listed in Section 2.3.1., fall under the mandate of the MoH. With the exception of the NMCP, the relevant disease programs are led by Coordinators who report to the National Director of Health (DNS). The NMCP is headed by a Director who reports directly to the Secretary General (ref: Section 2.2.1a). The majority of the VBD programs are, however, concentrated at the central level and have very little structures within the regions and districts. The NMCP, has focal point persons at the regional/intermediary and district levels – but not at the CSCOMs. However, there are no dedicated vector control focal points within the regions and districts. Vector control is implemented using the health personnel, primarily including the NMCP focal points where they exist, at the different health administrative levels. No VBDs control program has dedicated field staff. The required field staff needs to be recruited and trained and work under supervision for certain periods of the year. Since the current large scale vector control interventions are implemented at specific periods within the year, it is difficult if not exorbitant to maintain such field staff.

There is very little, in terms of intra-sectoral collaboration, although there are increasing opportunities – with the creation of a unified NTD program, etc. – to strengthen intra-sectoral collaboration with MOH through a national IVM strategy (see 3.2.1.2). There will, however, be a need to provide a legal and institutional framework in order to wean programs away from the entrenched culture of stand-alone operations.

Intersectoral collaboration is critical to effective management of the VBDs. This is because the local drivers of the disease transmission often extend beyond the purview of the MOH. There are other stakeholders whose actions or inactions contribute to the local transmission. Then, there are others whose mandates make them critical stakeholders to addressing the many issues linked with implementing ecologically sound, cost-effectiveness and sustainable IVM - including proper targeting of intervention, assuring human health and environmental safety, managing insecticide resistance in local vectors, community mobilization, and monitoring and evaluation of outcomes and

impacts. Collaboration with the ministry of environment is crucial for effective pesticide management, from the importation through to the disposal of the waste/container. While some limited sectoral collaboration exist, there will be a need to establish credible institutional frameworks that enable proactive mobilization of joint effort at all levels (central, regions, districts and communes).

2.3.5. Community Mobilization

An empowered community is critical for effectiveness of vector control efforts as such communities tend to provide a higher level of support, action and compliance from the community. Effective community mobilization efforts should adequately consider the broad range of social, economic, and livelihood concerns that determines or influence community support for any approached to IVM implementation.

The level of decentralization in Mali is advanced and local communities, through the local administrative mechanisms, participate in the decision-making and in planning and implementation of social, economic and health development programs. There are already very strong examples of community-based disease control efforts. Community penetration opportunities linked to the NTD MDA programs, as well as those linked to the LLIN campaigns – both described elsewhere in this report, provide excellent potential for enhanced mobilization drive under a future IVM implementation.

3. OPPORTUNITIES FOR ADDRESSING EXISTING CHALLENGES TO VECTOR CONTROL

3.1. Opportunities for Strengthening Policy for IVM

The major challenges identified from the review of VBDs control status are:

I. *Absence of national policies for some VBDs control programs;*
II. *Absence of an overarching and harmonized policy on vector control;*
III. *Absence of functional intra and inter-sectoral mechanism for regular review of policy effectiveness/impact*

IV. *Inadequate translation of existing strategies into work plans on, except for the malaria control program*

V. *Inadequate trained human resources in some critical areas of vector control*.

Relevant policies tend to be fragmented and embedded in individual VBDs control program and institutions. These programs and agencies pursue their policies often with minimal reference to each other – resulting with very intra or inter-sectoral collaboration. The creation of the multi-disease NTD program in 2007/8 affords a unique opportunity to build upon for multi-disease IVM approaches (for examples as lynphatis filariasis and malaria share the same vector).

A national inter-sectoral mechanism will need to be established to competently address the lack of intersectoral action. Such mechanism must have a clarified governmental mandate, providing relevant authority for policy recommendations and operational decisions to promote accountability among stakeholders on the control of VBDs. There should be clear rules to guide the conduct of Committee business (meeting and decision-making procedures, etc.). The establishment of the NISC should be informed by previous national experiences in inter-agency efforts, to make sure that previous lessons on constraints and effectiveness for such inter-sectoral work are adequately considered. As appropriate, an existing inter-agency structure could be reconfigured and mandated to serve as the NISC

A national intersectoral steering Committee (NISC) made up of high level personnel/experts from the relevant sectors is recommended under the auspices of the MOH and day to day leadership of the NMCP. .The NMCP representative should serve as focal point/liaison for the NISC. Primary stakeholder members of the NISC may include Ministries of Agriculture and Environment, because of their mandate on

Box 1: Potential Terms of Reference for National Intersectoral Committee (NISC)

- Review national policies relevant to vector borne diseases and develop a unified overarching national policy and strategies for their control
- Coordinate and provide oversight to the implementation of national IVM strategy and work plans, ensuring cost-effectiveness, efficiencies, and sharing of lessons/experiences
- Coordinate the mobilization of resources for intersectional action consistent with national aspirations for VBD control ensuring transparency and accountability
- Facilitate rationalized roles and responsibilities among stakeholders and evolve mechanisms to promote/ensure accountability.
- Undertake regular review of the implications of policies, strategies and work plans on VBDs and make recommendations to Government and appropriate authorities to enhance the achievement of national objectives.
- As may be required, constitute working groups drawing upon national and international expertise to address priority issues of concern
- Create opportunities for generating broad-based national consensus on issues and ensure that the genuine concerns of risk populations and communities are adequately considered.

pesticide regulation. Other likely stakeholders will include research outfits like MRTC and LBMA, as well as representation from private sector organization. The NISC should be senior enough (senior directors/heads of department), to make decisions on behalf of their agencies. Sample terms of references for the NISC are provided by Box 1. Other experts or stakeholders may be invited as advisers and/or observers. This may include developmental partners such as WHO and PMI.

3.2. Opportunities for strengthening institutional frameworks for IVM

The major challenges identified from the review of VBDs control status include:

i. *Absence of a substantive vector control unit or department within the MoH*
ii. *Absence of a substantive vector control section within the NMCP*
iii. *Insufficient intra-intersectoral collaboration on vector control*
iv. *Insufficient qualified human resources.*
v. *Insufficient integration of vector and vector control data into the national health information system*

In the absence of a substantive vector control Department within the MOH, the unified platform provided by the five NTDs control programs (schistosomiase & geohelminthiasis, trachoma, LF and onchocerciasis) presents an excellent opportunity for intra-sectoral collaboration within the MOH. It will be desirable to create a substantive vector control department in the MoH with direct report to the Secretary General. The department will then have some decision-making level to effectively coordinate vector control actions and be more rational in using limited resources. In the integration process, effort should be made to ensure that VBDs control programs understand the added value of integration. Integration of disease programs just for the sake of integration does not inherently guarantee greater efficiency or effectiveness. There will be a need for a way of work and reward process, which demonstrates that the resultant benefit of their combined efforts is greater than the sum of the benefits from each single program. This is important to avoid unnecessary competition between programs for resources. Pro-active intra-health sector collaboration will be a key component to the success of a national IVM strategy.

Similar principles hold true for inter-sectoral collaboration. Clear definition of sectoral/stakeholder functions and roles, as well as transparency and accountability are important criteria for successful collaboration. The Health Sector must provide leadership to the inter-sectoral collaboration. Because of its comparative advantage, in terms of competencies in health issues and mandate, it should lead efforts to develop relevant competencies in other sectors/ shakeholder partners so that they are able to undertake their functions effectively. Table 4 provides the potential roles of the the health and other sectors.

Table 4: Potential functions and roles for inter-sectoral action for health

Health Sector Functions
• Periodic eco-epidemiologic evaluation & surveillance, • Document and disseminate lessons • Update priority R&D needs and agenda • Establish and update institutional and operational frameworks • Harmonize relevant sectoral policies and legislation • Evaluate policy, institutional and operational framework • Identify sector-specific vector control measures, quality control of activities and monitor compliance • Capacity building
Functions of Other Sectors
• Include health criteria in sectoral operational frameworks and procedures • Undertake health impact assessment for new development projects and ensure the implementation of mitigation measures proposed for potential negative health impact • Vector control measures in line with sectoral mandates • Participate in joint activities of an integrated nature • Inform health sector on new technical and project developments

3.3. Strengthening human resources and systems for vector control

The WHO defines six major components of health system strengthening: leadership and governance; sustainable financing; workforce; methods, technologies and logistics; information systems. These components are also critical to successful IVM implementation.

3.3.1 Leadership and Governance

Through its five-year Health and Social Development program (PRODESS II), the MOH provides leadership to national health endeavors. All health activities must align with the priorities of the Government of Mali as set out in PRODESS II and Government anticipated effective evaluations to drive ongoing refinement of reforms required to further improve national health status. The NISC mechanism will ensure that a national IVM policy and related strategy are evaluated for effectiveness to enable improvement and facilitate the attainment of national objectives set out in PRODESS.

3.3.2. Sustainable Financing for IVM

IT is anticipated that detailed and multi-year costed work plan on IVM will be developed based on the IVM strategic plan. This will enable the NISC to evolve a corresponding resource mobilization strategy. The clarified national IVM strategy and work plan will enable developmental partners to better align their priorities with the stated national priorities and identify niches within the work plan they would want to directly support or contribute to. The multi-year work plan should also enable forward planning by government on local (in-country) budgetary allocation. The deliberate framework for monitoring and evaluation inherent in IVM implementation should result in improved matching of resource input with documented outcomes and/or impact. This should, in turn, promote the sense of ownership among policy and decision-makers.

3.3.3. Strengthening Information Systems for IVM

The existing health system, while able to provide information of curative services and diseases outcomes on Malaria and other diseases, is very scanty and inadequate on vector control related information. Vector control information comprise of just aggregates on LLINs (distributed and cross-sectional data on usage rates) as well as houses sprayed. There is hardly any information on local vectors and related ecology or entomological indicators that are relevant to assessing the overall effectiveness of LLINs and IRS, for example. An integrated information system on IVM will need to be established with the following characteristics:

i. Adequate capacity timely collection, management and utilization of data on specific vector species, disease eco-epidemiology, and progress of interventions, outcomes and impacts. Indicators or data sets to be measures/collected will need to be clearly defined, including the frequency of measurement, the standardized methodologies/procedures to be used and what quality control procedures should be in place to assure the integrity of the information collected.

ii. The ability at all levels, for timely and regular dissemination of level-appropriate information to both internal and external clients [program implementers, service providers, policy makers at these levels, and the general population]. This is to facilitate timely decisions to improve health outcomes. For example, district setups should be able to offer timely district-specific information on implementation, coverage and outcomes to local policy makers/implementers (Mayors/local administration, district and or regional health team, etc.).

iii. The capacity to effectively manage the expectation of policy makers and politically oriented concerns. This should be done through a functional policy review procedure (e.g. NISC) and principled used of gathered scientific data.

3.3.4. Vector Control Workforce

There is an urgent need to create a critical mass of trained personnel for the various VDBs programs in the country. Although the NMCP has relatively significant number of staff, there is only one

person with some training in entomology. As reviewed elsewhere in this report, the NMCP does not have a dedicated vector control unit. This constraints the proper execution program functions of overseeing field operations across such a vast country. The issue of carrier paths for entomologists and other vector control workers is particularly important as there have been incidents of well-trained entomologist abandoning their field for other technical pursuits perceived as having better prospects for carrier development.

Although there are well-equipped and highly skilled outfits like MRTC and LMBA, these tend to be centers of knowledge where often, principal researchers are engaged in more upstream research. Unless done through direct contractual engagement with attached remuneration or some other resource inflow, it is difficult to routinely have these skilled researchers continually engaged in the mundane and routine vector evaluations that are needed for day to day decisions of a vector control program (NMCP). The MOH should determine the staff placement and skill requirement at the various levels of program implementation (central, region, district and commune) (Table 5) and then engage MRTC and other such high level centers to conduct short field/practical-oriented courses

Table 5 Desirable IVM core functions and roles in Rwanda

National/Central Level	
• Strategic direction to programs • policy development • Standard settings, norms and M&E indicators • Program funding/resource mobilization • Prioritize and allocate financial resources • Epidemiologic analysis • Quality assurance • Training and support for district/Sector programs and vector control	• Coordination of emergency response • Evaluation and validation of operational research • Decision-making and planning of district programs/activities • Determine human resource needs • Monitor and evaluate district/Sector IVM implementation
District/Sector Level	

• Local planning of implementation • Resource prioritization and allocation • Disease surveillance • Program monitoring • Health education	• Train field staff/village health volunteers • Undertake vector control activities, assist in operational research • M&E: collection and initial collation of local data on various VC aspects)

in those technical areas to fill the staffing gaps. Recognizing the budgetary implication of such an undertaking – in particular, increase opportunities to reorient or expand the scope of responsibilities of existing staff should be explored. Within the context of IVM, competency/capacity development must be viewed across stakeholder entities. For example, entomologists in different programs could be pooled to address VDB issues, instead of the current pigeon-holed approach where programs require staff work only within the individual program mandate – missing crucial opportunities for collaboration and for enhancing efficiencies.

3.3.5. Enhancing Implementation: Tools, technologies and logistics

The major challenges identified from the review of VBDs control status include:

i. *Minimal deployment of malaria and trypanosomiasis vector control tools and almost no vector control tools for other VBDs*
ii. *Inadequate eco-epidemiological and entomological assessment*
iii. *Inadequate or absence of a monitoring/evaluation of intervention programs*
iv. *Inadequate technologies to support VBDs control programs*
v. *Lack of operational research to better orient the decision-making process*

The major vector control strategies in place in Mali target malaria vectors mainly and are run by the NMCP with the supports of donors. They are insecticide-treated bed nets (ITNs including LLINs) distribution and IRS.

The current policy calls for universal coverage, defined as one LLIN for two persons. To better assess the impact of interventions, it is important to have baseline information on the eco-epidemiology disease transmission, including vector ecology with which to compare subsequent evaluations.
A weakness in the current LLIN implementation is the absence of national capacity for effective monitoring of the field performance on the distributed nets. Two major factors may affect the performance of LLINs. Namely: (i) different types of LLINs are procured from different sources, as no single source can meet the high demand, (ii) difference in socio-cultural and environmental conditions. Difference in sleeping practices (urban versus rural, as well as cultural practices of southern versus northern tribes). The likely outcome is that the nets may reach the end of their useful life (i.e. ability to knock down vectors) at different times. Knowledge on when the LLINs reach the end of their useful life is important for planning and the timing of replacements – a critical aspect to the effective implementation of a national universal coverage strategy.
Such Longitudinal field monitoring can be undertaken by MRTC, the national laboratory of health and the national veterinary laboratory (LNS=*Laboratoire National de la Santé*; LCV=*Laboratoire National Vétérinaire*). These laboratories have the expertise and the technology/equipment, although often funding for reagents and supplies limit their capacities (chromatography) for assessing the chemical residues.

The human and the vector behaviors play an important role in the effectiveness interventions like LLINs and IRS that are predicated on indoor biting and indoor resting behavior of mosquito vectors. The outdoors resting behavior of malaria vectors was one the main reasons of the Garki Project's failure (see in Riehle et al, 2011). In tropical hot areas like Mali, people are believed to stay out at night for long time therefore perceived to get infective bites before they go under the bed nets. Questions are raised on the impact of such behaviors on malaria burden by both the NMCP and its partner such as the PMI. These questions also raise the need for developing operational research to help authorities for making evidence-based decisions. A credible anthropological survey coupled with evaluation of vector biting behavior/preferences (i.e. extent of outdoor and crepuscular

feeding among local malaria vectors), may shed light on the issue facilitate additional strategies to address any transmission loopholes to realize the full benefit of IRS and LLINs.

Vector control requires clearly defined monitoring and evaluation scheme ongoing assessment of effectiveness. Table 6 provides some of the evaluations needed. The bottleneck for Mali is insufficient numbers of qualified personnel to conduct monitoring and evaluation activities when the interventions are scaled up. That is why a strategy for creating a critical mass of field technicians (as previously described), is crucial.

The combination of different interventions could also be explored. Elsewhere combinations of IRS and bed nets with other control methods have proven efficient (Pei-Wen *et al*, 2010). However country specificities in terms of disease eco-epidemiology and operational feasibility should be taken into account in order to define appropriate combinations. In Mali a pilot operational research investigated the added value of larviciding to IRS (combination IRS-Larviciding). This showed a considerable reduction in larval densities. These types of studies should be encouraged in more optimal condition to assess the impact of the impact of combinations on the VDBs taking into account the cost effectiveness, a principle for IVM.

There is a need to strengthen national capacity for effective logistics in vector control at all the levels of the health system. IRS and LLINs distributions require a very high level of logistics. Appropriate logistics should be available at appropriate levels (national, regional/intermediary and district/community).

The other vector control strategy in use targets tse-tse flies to control trypanosomiasis. The main method used is the insecticide baited traps. This program is implemented by PATTEC. The covered areas and the other proposed methods to be used are described in section 3.1.1.5.

Table 6 Desirable Entomological and Eco-epidemiological Evaluations for IVM (Rwanda)

Category 1 *Basic Entomological Evaluation (monthly)*
1. Species composition & morphological identification (monthly)

2. Vector density (adult: indoors/outdoors and larva) 3. Landing catches 4. WHO wall bioassay of IRS insecticide residual efficacy 5. Vector susceptibility tests [CDC bottle assay]- 2x/year for WHOPES approved insecticides
***Category 2**: Entomological Evaluation with enhanced capacity*
Yearly 1 monthly baseline followed by frequency indicated: 1. Vector identification (genetic) density & population structure (quarterly) 2. Sporozoite rate (quarterly) 3. Entomological inoculation rate (quarterly) 4. Blood meal analysis (quarterly) 5. Parity (quarterly) 6. PCR-based vector resistance (annual) 7. LLIN Effectiveness evaluation (annual)
***Other:** Eco-epidemiological/Biological factors*
1. Meteorological: rainfall, humidity, temperature etc. 2. Larval productivity: water temp, transparency, nutrients, and other vector breeding place characterization 3. Utilization of LLINs or IRS coverage 4. Housing structure versus vector biting rate/EIR risks 5. Population based parasitemia 6. Socio-economic status

3.3.6. Opportunities for community mobilization

Community mobilization is a critical component for successful and sustainable implementation of any vector control endeavor. Section 3.3.5 briefly reviews some of the existing opportunities for community mobilization in Mali.

Effective mobilization of communities will require the active involvement of opinions leaders and groups. This will include religious leaders, women's associations, youth associations, villagers' associations, community health workers (relays, community health agents, health zone agents etc.), villages leadership (chief of villages and their staff). Local administrations (including municipalities), will play crucial roles.

Effective community mobilization will require well-tailored IEC/BCC strategies. Diverse information sources should be used, including Print media and radio and TV (national and local stations).

Information must be in local dialect, as necessary. In this direction the center for health information and communication (CNIECS) of the MoH could play a coordinating role both within the health sector and with other stakeholders.

4. FOLLOW UP STEPS

Processes for translating the findings and broad recommendations from the VCNA into the development of a national IVM strategy and work plans are summarized in Table 6. The VCNA findings does not constitute guidance for step by step instructions on how to control or eliminate a particular vector population, solve constraints identified or designate the roles and responsibilities potential stakeholders. VCNA is a first step in a larger process aimed at providing a framework for informed and structured deliberation among national stakeholders sectors to, (i) recalibrate national goals and strategies on VBDs and (ii) evolve feasible and measurable work plans to address constraints to national vector control endeavors in a comprehensive manner. The VCNA indicates where bridges between different stakeholders can be built to strengthen the efficiency and effectiveness of partner and joint actions. The opportunities identified in this report for overcoming the identified challenges to vector control, will need further evaluation within an intersectoral setting. A NSIC, as previously described should oversee and facilitate a transparent process of transitioning current vector control to a full fledge IVM.

Table 7 Follow-up Steps to Develop a National IVM Strategy and Work plan

Follow up		Steps
A. National Intersectoral Steering Committee (NISC)	Review Vector Control Needs Assessment (VCNA) Report	• MoH appraises VCNA report, attaches observation and recommendations on report as annexes informed by national priority strategies and vector control options. • Submit final VCNA report and recommendations to key stakeholders of Health. Includes proposals to establish NISC and broad national consultative mechanism (BCM) to involve all major stakeholders (public/private)

	Establish a NISC	• MoH identify major national stakeholder for vector control and constitute a National Intersectoral Committee on Integrated Vector Management (NISC). • Convene meeting, establish agenda and terms of reference. • Set broad targets for vector control.
	Develop IVM strategy and work plan	• MoH leads development of a draft action plan for effective IVM implementation – ensuring adequate considerations of the findings and recommendations of the VCNA and full consultation with stakeholders • Plan of action submitted to NISC for review and endorsement; modify as necessary. • Organize a national consensus meeting to gain a wider acceptance; finalize and ratify plan. • NISC mobilizes or negotiates resources for action plan. • Provide ongoing over site and guidance to implementation.

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National Department for sanitation and for Pollution and Nuisance Control
National department of Agriculture
National Department of Territorial Collectivities
National Division for public Sanitation and Health (DHPS)
National Health Department
National Lymphatic Filariasis Elimination Program
National Malaria Control Program
National Onchocerciasis Control Program
National Schistosomiasis Control Program
National Trypanosomiasis & geohelminthiasis Control Program
Pan-African Trypanosomiasis and Tse-tse Elimination Campaign (PATTEC)
PASP-Mali
Plants Protection Office (OPV)
RTI International
World Health Organization (Mali office)

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